

Appl. No. : 10/038,305
Filed : January 2, 2002

REMARKS

In the Office Action mailed on October 7, 2003, the Examiner rejected all pending claims, Claims 2-10 and 17-23. Applicants respectfully request full consideration of the remarks contained herein.

Amendments to the Specification and Objections to the Title

The Examiner has objected to the title, "METHOD OF FORMING A DUAL DAMASCENE INTERCONNECT," as "not descriptive." In response, Applicants have amended the title to recite "METHOD OF FORMING A DUAL DAMASCENE INTERCONNECT BY SELECTIVE METAL DEPOSITION" to more clearly indicate the invention to which the claims are directed. Applicants respectfully submit that the amendment adds no new matter and is fully supported by the Application as originally filed. *See, e.g.*, the Application, pp. 5 and 8-9, and Claims 1 and 11, as originally filed. Consequently, Applicants respectfully submit that the objection to the title is overcome.

Rejections Under 35 U.S.C. § 103(a)

The Examiner has rejected Claims 2-9 and 17-20 under 35 U.S.C. § 103(a) as being unpatentable over Havemann (U.S. Patent No. 6,156,651) in view of various secondary references. The Examiner has stated that Havemann explicitly teaches all of the limitations of independent Claims 6 and 17, except for metal deposition to between about "one-third and two-thirds" of the height of a contact via. The Examiner has stated that this limitation would be obvious in view of the teachings of Havemann. In particular, the Examiner has stated that Havemann teaches that "the selective deposition fills the via to less than the height of the interlevel dielectric, and stop filling prior to reaching the top of the interlevel dielectric layer (see figure 6C, col. 5, lines 39-41, 54-61) would obviously means that filling the contact via with the metal to the height between about one-third and two-thirds (meeting claims 6-7, and 17-18).

Applicants respectfully traverse the rejections.

Initially, Applicants note that even where a prior art reference teaches a range encompassing a narrower claimed range, the claimed range is still patentable if the criticality of the range is shown. *See In re Woodruff*, 919 F.2d 1575, 16 U.S.P.Q. 2d 1362 (Fed. Cir. 1990)

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("the law is replete with cases in which the difference between the claimed invention and the prior art is some range or other variable within the claims"). As discussed in Applicants' Remarks Accompanying Request for Continued Examination filed July 22, 2003, it is well-established that the recitation of a narrower range or numerical limitation can lend patentability to a claim where the range is shown to be critical and where the prior art does not recognize the importance of that range. For example, in *In re Antonie*, 559 F.2d 618, 195 U.S.P.Q. 6 (C.C.P.A. 1977), the prior art disclosed the general features of the claims, directed to a wastewater treatment device. Nevertheless, the court found that the claims were patentable because these recited a "ratio of tank volume to contractor area of 0.12 gal./sq. ft.³." While the prior art, by teaching the existence of a tank and a contractor, could be said to have implicitly taught a ratio of tank volume to contractor generally, the court found the recitation of a particular ratio and the lack of recognition by the prior of the importance of the ratio lent patentability to the claims.

Likewise, in *In re Rijckaert*, 9 F.3d 1531, 28 U.S.P.Q.2d 1955 (Fed. Cir. 1993), the prior art disclosed the general features of the claimed device, except for a particular operational relationship. The court found that the recitation of the relationship, a "time-base correction circuit provid[ing] a time expansion or time compression of the signal blocks by a factor of $\alpha * n / (180 * (M + 1))$," served to distinguish the prior art. In particular, the court found that the prior art did not recognize the criticality of this relationship nor did the prior provide a teaching suggesting this relationship. Consequently, the court found the claims in that case were patentable.

In the present case, Applicants submit that the specification establishes the criticality of the recited deposition levels and that the prior art fails to recognize the importance of these levels. Applicants note that the claims recite both a particular level of filling, "between about one-third and two-thirds" of the height of a contact via, and the type of metal used in the filling, first a less conductive and then a more conductive metal. In working with these metals, Applicants have found that deposition into contact vias with available deposition techniques for more conductive metals can result in inadequate filling of the contact vias, while deposition with less conductive metals is more readily accomplished and is more likely to adequately fill the vias. See, e.g., p. 2 of the Application. Because the lower conductivity metal adversely affects the conductivity of the resulting integrated circuit or contact plug, Applicants have found that it is

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important to minimize the amount of the lower conductivity metal present. Thus, to balance the deposition behavior of these metals with their conductivities, Applicants have found that the deposition of the more conductive metal can be facilitated by raising the floor of the contact via to decrease the effective aspect ratio of the contact via before depositing the more conductive metal. By raising the contact via floor with a less conductive metal, the more conductive metals can be deposited so that they adequately fill the contact via. To realize these benefits, Applicants have found it is most advantageous to fill "between about one-thirds and two-thirds" of the contact via height with the less conductive metal. *See, e.g.*, pp. 8 and 11 of the Application.

Applicants note that the art of record does not recognize any of the problems discussed in the specification nor does the prior art recognize their advantageous solutions. For example, the art of record does not recognize the dependence of the deposition levels of the metals on the conductivities of the metals, the deposition behavior of the metals and the conductivity of the resultant integrated circuit or contact plug. In particular, Applicants note that Havemann simply teaches that the contact via should not be completely filled, but does not teach any particular level of deposition. As such, just as recognition of the criticality of a numerical limitation and the recitation of that limitation lent patentability to the claims at issue in *In re Antonie* and *In re Rijckaert*, Applicants submit that the criticality of the amount of the lower conductivity metal filling the contact via and complete lack of guidance in the art of record regarding particular deposition levels lends patentability to the pending claims. Consequently, Applicants submit that art of record does not render obvious the *particular* levels recited in independent Claims 6 and 17.

Moreover, Applicants note that the claims recite a particular combination of metals, with a less conductive metal at a bottom portion of a contact via and a more conductive metal at a top portion of a contact via. In view of this limitation, Applicants note that it is well-established that not only must the prior art teach all the elements recited in the claims, but the prior art must also teach or suggest arranging these elements in the *particular manner* claimed. *See In re Kotzab*, 55 U.S.P.Q. 2d 1313, 1318 (Fed. Cir. 2000) ("particular findings must be made as to the reason the skilled artisan, with no knowledge of the claimed invention, would have selected these components for combination *in the manner claimed*.") (emphasis added); *see also, In re Newell*, 891 F.2d 899, 13 U.S.P.Q.2d 1248, 1250 (Fed. Cir. 1989) ("some teaching or suggestion which

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supports the selection and use of the various elements in the *particular claimed combination*" must be shown to establish obviousness) (emphasis added).

In this case, however, Havemann merely teaches a list of metals and only teaches depositing metals of the same conductivity in upper and lower portions of a contact via; in particular, Havemann's only example teaches depositing aluminum over aluminum. See Havemann, Col. 6, lines 40-46. Consequently, Applicants submit that art of record does not provide any suggestion to make the particular combination claimed by Applicants. Rather, Applicants submit that the Examiner has impermissibly picked more conductive metals from among Havemann's listed metals for the upper metal, and picked less conductive metals from among Havemann's listed metals for the lower metals, with only Applicants' disclosure to guide these choices in hindsight. In particular, in the present case, the only discussion of record of why a lower conductivity metal should be deposited first into a contact via, followed by a higher conductivity metal comes from Applicants' disclosure. It is well-established, however, that it is "impermissible ... simply to engage in a hindsight reconstruction of the claimed invention, using the applicant's structure as a template and selecting elements from references to fill the gaps." See *In re Gorman*, 933 F.2d 982, 18 U.S.P.Q.2d 1885 (Fed. Cir. 1991)). In view of the deficiencies of the art of record, Applicants submit that the art of record does not establish a *prima facie* case of obviousness.

Accordingly, Applicants respectfully submit that the pending claims are allowable over the art of record. Applicants have not specifically addressed the rejections of dependent claims as being moot in view of the remarks herein, nor have Applicants specifically addressed the asserted teachings of the art of record apart from Havemann. However, Applicants expressly do not acquiesce in the Examiner's findings not addressed herein. Moreover, Applicants submit that the dependent claims recite further distinguishing and non-obvious features of particular utility.

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CONCLUSIONS

In view of the foregoing amendments and remarks, Applicants request entry of the amendments and submit that the application is in condition for allowance and respectfully request the same. If some issue remains which the Examiner feels may be addressed by Examiner's amendment, the Examiner is cordially invited to call the undersigned for authorization.

Please charge any additional fees, including any fees for additional extension of time, or credit overpayment to Deposit Account No. 11-1410.

Respectfully submitted,

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